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Maps of Bounded Rationality: Psychology for Behavioral Economics
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Source: *The American Economic Review*, Vol. 93, No. 5 (Dec., 2003), pp. 1449-1475
Published by: American Economic Association
Stable URL: http://www.jstor.org/stable/3132137
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Maps of Bounded Rationality: Psychology for Behavioral Economics[†]

By DANIEL KAHNEMAN*

The work cited by the Nobel committee was done jointly with Amos Tversky (1937–1996) during a long and unusually close collaboration. Together, we explored the psychology of intuitive beliefs and choices and examined their bounded rationality. Herbert A. Simon (1955, 1979) had proposed much earlier that decision makers should be viewed as boundedly rational, and had offered a model in which utility maximization was replaced by satisficing. Our research attempted to obtain a map of bounded rationality, by exploring the systematic biases that separate the beliefs that people have and the choices they make from the optimal beliefs and choices assumed in rational-agent models. The rational-agent model was our starting point and the main source of our null hypotheses, but Tversky and I viewed our research primarily as a contribution to psychology, with a possible contribution to economics as a secondary benefit. We were drawn into the interdisciplinary conversation by economists who hoped that psychology could be a useful source of assumptions for economic theorizing, and indirectly a source of hypotheses for economic research (Richard H. Thaler, 1980, 1991, 1992). These hopes have been realized to some extent, giving rise to an active program of research by behavioral economists (Thaler, 2000; Colin Camerer et al., forthcoming; for other examples, see Kahneman and Tversky, 2000).

My work with Tversky comprised three separate programs of research, some aspects of which were carried out with other collaborators. The first explored the heuristics that people use and the biases to which they are prone in various tasks of judgment under uncertainty, including predictions and evaluations of evidence (Kahneman and Tversky, 1973; Tversky and Kahneman, 1974; Kahneman et al., 1982). The second was concerned with prospect theory, a model of choice under risk (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992) and with loss aversion in riskless choice (Kahneman et al., 1990, 1991; Tversky and Kahneman, 1991). The third line of research dealt with framing effects and with their implications for rational-agent models (Tversky and Kahneman, 1981, 1986). The present essay revisits these three lines of research in light of recent advances in the psychology of intuitive judgment and choice. Many of the ideas presented here were anticipated informally decades ago, but the attempt to integrate them into a coherent approach to judgment and choice is recent.

Economists often criticize psychological research for its propensity to generate lists of errors and biases, and for its failure to offer a coherent alternative to the rational-agent model. This complaint is only partly justified: psychological theories of intuitive thinking cannot match the elegance and precision of formal normative models of belief and choice, but this is just another way of saying that rational models are psychologically unrealistic. Furthermore, the alternative to simple and precise models is not chaos. Psychology offers integrative concepts and mid-level generalizations, which gain credibility from their ability to explain ostensibly different phenomena in diverse domains. In this spirit, the present essay offers a unified

[†] This article is a revised version of the lecture Daniel Kahneman delivered in Stockholm, Sweden, on December 8, 2002, when he received the Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel. The article is copyright © The Nobel Foundation 2002 and is published here with the permission of the Nobel Foundation.

* Woodrow Wilson School, Princeton University, Princeton, NJ 08544 (e-mail: Kahneman@princeton.edu). This essay revisits problems that Amos Tversky and I studied together many years ago, and continued to discuss in a conversation that spanned several decades. It builds on an analysis of judgment heuristics that was developed in collaboration with Shane Frederick (Kahneman and Frederick, 2002). A different version was published in *American Psychologist* in September 2003. For detailed comments on this version I am grateful to Angus Deaton, David Laibson, Michael Rothschild, and Richard Thaler. The usual caveats apply. Geoffrey Goodwin, Amir Goren, and Kurt Schoppe provided helpful research assistance.

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treatment of intuitive judgment and choice, which builds on an earlier study of the relationship between preferences and attitudes (Kahneman et al., 1999) and extends a model of judgment heuristics recently proposed by Kahneman and Shane Frederick (2002). The guiding ideas are (i) that most judgments and most choices are made intuitively; (ii) that the rules that govern intuition are generally similar to the rules of perception. Accordingly, the discussion of the rules of intuitive judgments and choices will rely extensively on visual analogies.

Section I introduces a distinction between two generic modes of cognitive function, corresponding roughly to intuition and reasoning. Section II describes the factors that determine the relative accessibility of different judgments and responses. Section III relates prospect theory to the general proposition that changes and differences are more accessible than absolute values. Section IV explains framing effects in terms of differential salience and accessibility. Section V reviews an attribute substitution model of heuristic judgment. Section VI describes a particular family of heuristics, called prototype heuristics. Section VII discusses the interactions between intuitive and deliberate thought. Section VIII concludes.

I. The Architecture of Cognition: Two Systems

The present treatment distinguishes two modes of thinking and deciding, which correspond roughly to the everyday concepts of reasoning and intuition. Reasoning is what we do when we compute the product of 17 by 258, fill an income tax form, or consult a map. Intuition is at work when we read the sentence "Bill Clinton is a shy man" as mildly amusing, or when we find ourselves reluctant to eat a piece of what we know to be chocolate that has been formed in the shape of a cockroach (Paul Rozin and Carol Nemeroff, 2002). Reasoning is done deliberately and effortfully, but intuitive thoughts seem to come spontaneously to mind, without conscious search or computation, and without effort. Casual observation and systematic research indicate that most thoughts and actions are normally intuitive in this sense (Daniel T. Gilbert, 1989, 2002; Timothy D. Wilson, 2002; Seymour Epstein, 2003).

Although effortless thought is the norm, some monitoring of the quality of mental operations and overt behavior also goes on. We do not express every passing thought or act on every impulse. But the monitoring is normally lax, and allows many intuitive judgments to be expressed, including some that are erroneous (Kahneman and Frederick, 2002). Ellen J. Langer et al. (1978) provided a well-known example of what she called "mindless behavior." In her experiment, a confederate tried to cut in line at a copying machine, using various preset "excuses." The conclusion was that statements that had the form of an unqualified request were rejected (e.g., "Excuse me, may I use the Xerox machine?"), but almost any statement that had the general form of an explanation was accepted, including "Excuse me, may I use the Xerox machine because I want to make copies?" The superficiality is striking.

Frederick (2003, personal communication) has used simple puzzles to study cognitive self-monitoring, as in the following example: "A bat and a ball cost $1.10 in total. The bat costs $1 more than the ball. How much does the ball cost?" Almost everyone reports an initial tendency to answer "10 cents" because the sum $1.10 separates naturally into $1 and 10 cents, and 10 cents is about the right magnitude. Frederick found that many intelligent people yield to this immediate impulse: 50 percent (47/93) of a group of Princeton students and 56 percent (164/293) of students at the University of Michigan gave the wrong answer. Clearly, these respondents offered their response without first checking it. The surprisingly high rate of errors in this easy problem illustrates how lightly the output of effortless associative thinking is monitored: people are not accustomed to thinking hard, and are often content to trust a plausible judgment that quickly comes to mind. Remarkably, Frederick has found that errors in this puzzle and in others of the same type were significant predictors of high discount rates.

In the examples discussed so far, intuition was associated with poor performance, but intuitive thinking can also be powerful and accurate. High skill is acquired by prolonged practice, and the performance of skills is rapid and effortless. The proverbial master chess player who walks past a game and declares "white mates in three" without slowing is performing intuitively (Simon and William G. Chase, 1973), as is the experienced nurse who

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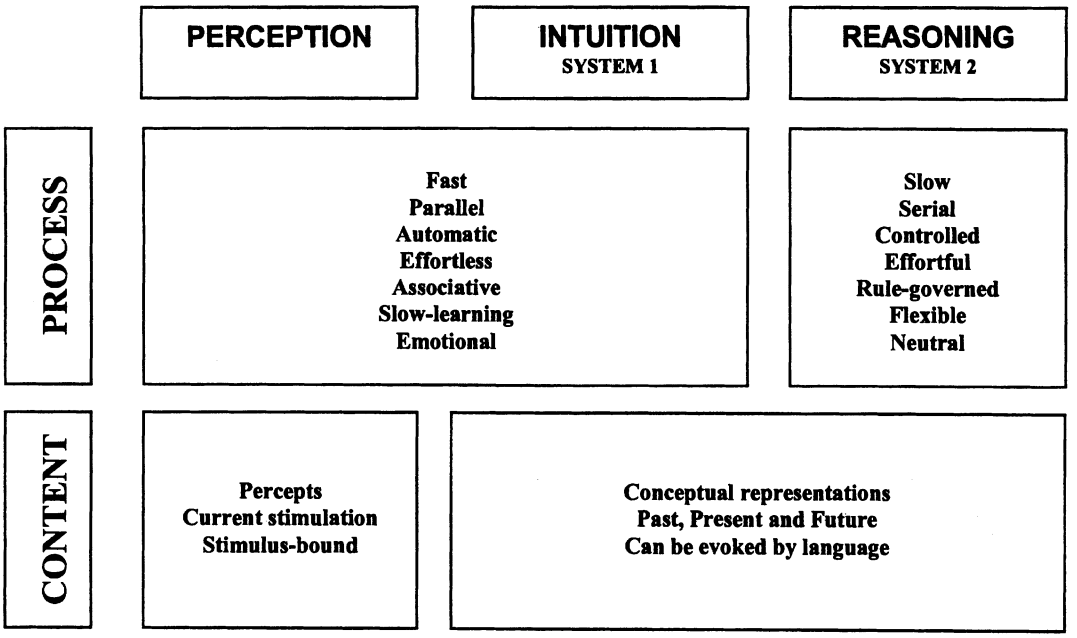

FIGURE 1. THREE COGNITIVE SYSTEMS

detects subtle signs of impending heart failure (Gary Klein, 1998; Atul Gawande, 2002).

The distinction between intuition and reasoning has recently been a topic of considerable interest to psychologists (see, e.g., Shelly Chaiken and Yaacov Trope, 1999; Gilbert, 2002; Steven A. Sloman, 2002; Keith E. Stanovich and Richard F. West, 2002). There is substantial agreement on the characteristics that distinguish the two types of cognitive processes, for which Stanovich and West (2000) proposed the neutral labels of System 1 and System 2. The scheme shown in Figure 1 summarizes these characteristics. The operations of System 1 are fast, automatic, effortless, associative, and often emotionally charged; they are also governed by habit, and are therefore difficult to control or modify. The operations of System 2 are slower, serial, effortful, and deliberately controlled; they are also relatively flexible and potentially rule-governed.

The difference in effort provides the most useful indications of whether a given mental process should be assigned to System 1 or System 2. Because the overall capacity for mental effort is limited, effortful processes tend to disrupt each other, whereas effortless processes neither cause nor suffer much interference when combined with other tasks. For example, a driver's ability to conduct a conversation is a sensitive indicator of the amount of attention currently demanded by the driving task. Dual tasks have been used in hundreds of psychological experiments to measure the attentional demands of different mental activities (for a review, see Harold E. Pashler, 1998). Studies using the dual-task method suggest that the self-monitoring function belongs with the effortful operations of System 2. People who are occupied by a demanding mental activity (e.g., attempting to hold in mind several digits) are much more likely to respond to another task by blurting out whatever comes to mind (Gilbert, 1989). The phrase that "System 2 monitors the activities of System 1" will be used here as shorthand for a hypothesis about what would happen if the operations of System 2 were disrupted. For example, it is safe to predict that the percentage of errors in the bat-and-ball question will increase, if the respondents are asked this question while attempting to keep a list of words in their active memory.

In the language that will be used here, the perceptual system and the intuitive operations

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of System 1 generate *impressions* of the attributes of objects of perception and thought. These impressions are not voluntary and need not be verbally explicit. In contrast, *judgments* are always explicit and intentional, whether or not they are overtly expressed. Thus, System 2 is involved in all judgments, whether they originate in impressions or in deliberate reasoning. The label "intuitive" is applied to judgments that directly reflect impressions.

Figure 1 illustrates an idea that guided the research that Tversky and I conducted from its early days: that intuitive judgments occupy a position—perhaps corresponding to evolutionary history—between the automatic operations of perception and the deliberate operations of reasoning. All the characteristics that students of intuition have attributed to System 1 are also properties of perceptual operations. Unlike perception, however, the operations of System 1 are not restricted to the processing of current stimulation. Like System 2, the operations of System 1 deal with stored concepts as well as with percepts, and can be evoked by language. This view of intuition suggests that the vast store of scientific knowledge available about perceptual phenomena can be a source of useful hypotheses about the workings of intuition. The strategy of drawing on analogies from perception is applied in the following section.

II. The Accessibility Dimension

A defining property of intuitive thoughts is that they come to mind spontaneously, like percepts. The technical term for the ease with which mental contents come to mind is *accessibility* (E. Tory Higgins, 1996). To understand intuition, we must understand why some thoughts are accessible and others are not. The remainder of this section introduces the concept of accessibility by examples drawn from visual perception.

Consider Figures 2a and 2b. As we look at the object in Figure 2a, we have immediate impressions of the height of the tower, the area of the top block, and perhaps the volume of the tower. Translating these impressions into units of height or volume requires a deliberate operation, but the impressions themselves are highly accessible. For other attributes, no perceptual impression exists. For example, the total area that the blocks would cover if the tower were

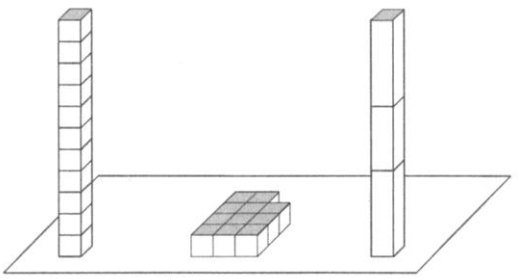

FIGURE 2. EXAMPLES OF DIFFERENTIAL ACCESSIBILITY

dismantled is not perceptually accessible, though it can be estimated by a deliberate procedure, such as multiplying the area of a block by the number of blocks. Of course, the situation is reversed with Figure 2b. Now the blocks are laid out and an impression of total area is immediately accessible, but the height of the tower that could be constructed with these blocks is not.

Some relational properties are accessible. Thus, it is obvious at a glance that Figures 2a and 2c are different, but also that they are more similar to each other than either is to Figure 2b. And some statistical properties of ensembles are accessible, while others are not. For an example, consider the question "What is the average length of the lines in Figure 3?" This question is easy. When a set of objects of the same general kind is presented to an observer—whether simultaneously or successively—a representation of the set is computed automatically, which includes quite precise information about the average (Dan Ariely, 2001; Sang-Chul Chong and Anne Treisman, 2003). The representation of the prototype is highly accessible, and it has the character of a percept: we form an impression of the typical line without choosing to do so. The only role for System 2 in this task is to map the impression of typical length onto the appropriate scale. In contrast, the answer to the question "What is the total length of the lines in the display?" does not come to mind without considerable effort.

As the example of averages and sums illustrates, some attributes are more accessible than others, both in perception and in judgment. Attributes that are routinely and automatically produced by the perceptual system or by System

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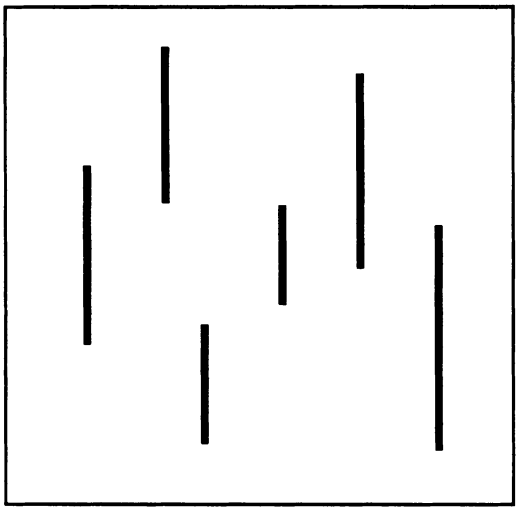

FIGURE 3. DIFFERENTIAL ACCESSIBILITY OF STATISTICAL PROPERTIES

1, without intention or effort, have been called *natural assessments* (Tversky and Kahneman, 1983). Kahneman and Frederick (2002) compiled a partial list of these natural assessments. In addition to physical properties such as size, distance, and loudness, the list includes more abstract properties such as similarity, causal propensity, surprisingness, affective valence, and mood.

The evaluation of stimuli as good or bad is a particularly important natural assessment. The evidence, both behavioral (John A. Bargh, 1997; Robert B. Zajonc, 1998) and neurophysiological (e.g., Joseph E. LeDoux, 2000), is consistent with the idea that the assessment of whether objects are good (and should be approached) or bad (should be avoided) is carried out quickly and efficiently by specialized neural circuitry. A remarkable experiment reported by Bargh (1997) illustrates the speed of the evaluation process, and its direct link to approach and avoidance. Participants were shown a series of stimuli on a screen, and instructed to respond to each stimulus as soon as it appeared, by moving a lever that blanked the screen. The stimuli were affectively charged words, some positive (e.g., LOVE) and some aversive (e.g., VOMIT), but this feature was irrelevant to the participant's task. Half the participants responded by pulling the lever toward themselves, half responded by pushing the lever away. Although the response was initiated within a fraction of a second, well before the meaning of the stimulus was consciously registered, the emotional valence of the word had a substantial effect. Participants were relatively faster in pulling a lever toward themselves (approach) for positive words, and relatively faster pushing the lever away when the word was aversive. The tendencies to approach or avoid were evoked by an automatic process that was not under conscious voluntary control. Several psychologists have commented on the influence of this primordial evaluative system (here included in System 1) on the attitudes and preferences that people adopt consciously and deliberately (Zajonc, 1998; Kahneman et al., 1999; Paul Slovic et al., 2002; Epstein, 2003).

The preceding discussion establishes a dimension of accessibility. At one end of this dimension we find operations that have the characteristics of perception and of the intuitive System 1: they are rapid, automatic, and effortless. At the other end are slow, serial, and effortful operations that people need a special reason to undertake. Accessibility is a continuum, not a dichotomy, and some effortful operations demand more effort than others. Some of the determinants of accessibility are probably genetic; others develop through experience. The acquisition of skill gradually increases the accessibility of useful responses and of productive ways to organize information, until skilled performance becomes almost effortless. This effect of practice is not limited to motor skills. A master chess player does not see the same board as the novice, and visualizing the tower in an array of blocks would also become virtually effortless with prolonged practice.

The impressions that become accessible in any particular situation are mainly determined, of course, by the actual properties of the object of judgment: it is easier to see a tower in Figure 2a than in Figure 2b, because the tower in the latter is only virtual. Physical salience also determines accessibility: if a large green letter and a small blue letter are shown at the same time, "green" will come to mind first. However, salience can be overcome by deliberate attention: an instruction to look for the small object will enhance the accessibility of all its features.

Analogous effects of salience and of spontaneous and voluntary attention occur with more abstract stimuli. For example, the statements "Team A beat team B" and "Team B lost to

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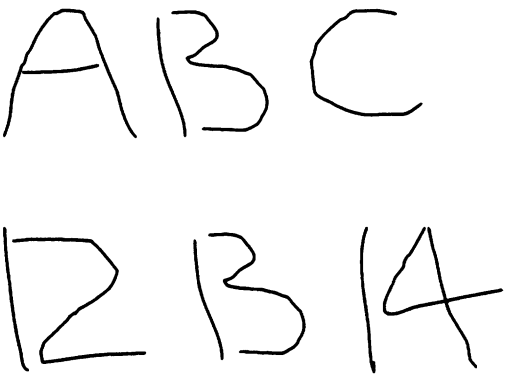

FIGURE 4. AN EFFECT OF CONTEXT ON ACCESSIBILITY

team A" convey the same information, but because each sentence draws attention to its grammatical subject, they make different thoughts accessible. Accessibility also reflects temporary states of associative activation. For example, the mention of a familiar social category temporarily increases the accessibility of the traits associated with the category stereotype, as indicated by a lowered threshold for recognizing behaviors as indications of these traits (Susan T. Fiske, 1998).

As designers of billboards know well, motivationally relevant and emotionally arousing stimuli spontaneously attract attention. Billboards are useful to advertisers because paying attention to an object makes all its features accessible—including those that are not linked to its primary motivational or emotional significance. The "hot" states of high emotional and motivational arousal greatly increase the accessibility of thoughts that relate to the immediate emotion and to the current needs, and reduce the accessibility of other thoughts (George Loewenstein, 1996, 2000; Jon Elster, 1998). An effect of emotional significance on accessibility was demonstrated in an important study by Yuval Rottenstreich and Christopher K. Hsee (2001), which showed that people are less sensitive to variations of probability when valuing chances to receive emotionally loaded outcomes (kisses and electric shocks) than when the outcomes are monetary.

Figure 4 (adapted from Jerome S. Bruner and A. Leigh Minturn, 1955) includes a standard demonstration of the effect of context on accessibility. An ambiguous stimulus that is perceived as a letter within a context of letters is instead seen as a number when placed within a context of numbers. More generally, expectations (conscious or not) are a powerful determinant of accessibility.

Another important point that Figure 4 illustrates is the complete suppression of ambiguity in conscious perception. This aspect of the demonstration is spoiled for the reader who sees the two versions in close proximity, but when the two lines are shown separately, observers will not spontaneously become aware of the alternative interpretation. They "see" the interpretation of the object that is the most likely in its context, but have no subjective indication that it could be seen differently. Ambiguity and uncertainty are suppressed in intuitive judgment as well as in perception. Doubt is a phenomenon of System 2, an awareness of one's ability to think incompatible thoughts about the same thing. The central finding in studies of intuitive decisions, as described by Klein (1998), is that experienced decision makers working under pressure (e.g., firefighting company captains) rarely need to choose between options because, in most cases, only a single option comes to mind.

The compound cognitive system that has been sketched here is an impressive computational device. It is well-adapted to its environment and has two ways of adjusting to changes: a short-term process that is flexible and effortful, and a long-term process of skill acquisition that eventually produces highly effective responses at low cost. The system tends to see what it expects to see—a form of Bayesian adaptation—and it is also capable of responding effectively to surprises. However, this marvelous creation differs in important respects from another paragon, the rational agent assumed in economic theory. Some of these differences are explored in the following sections, which review several familiar results as effects of accessibility. Possible implications for theorizing in behavioral economics are explored along the way.

III. Changes or States: Prospect Theory

A general property of perceptual systems is that they are designed to enhance the accessibility of changes and differences. Perception is *reference-dependent:* the perceived attributes of a focal stimulus reflect the contrast between that stimulus and a context of prior and concurrent stimuli. This section will show that

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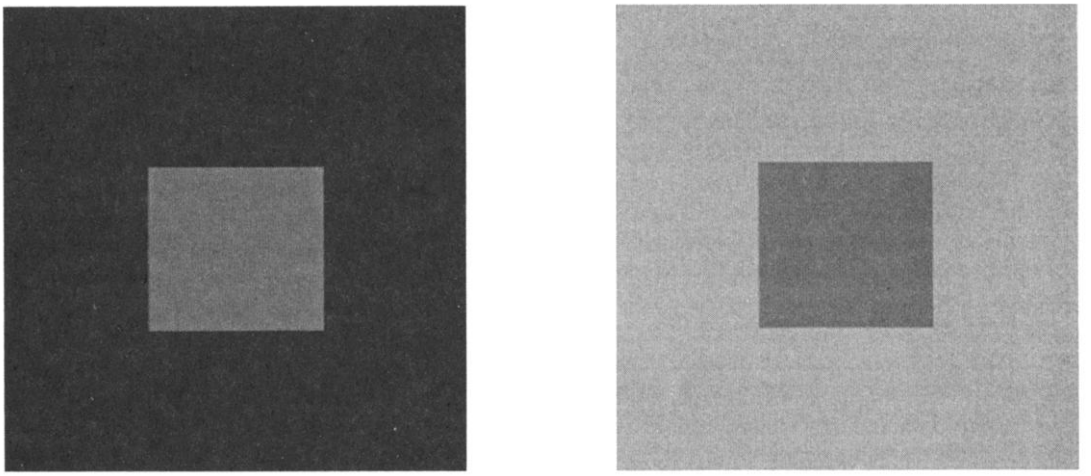

FIGURE 5. REFERENCE-DEPENDENCE IN THE PERCEPTION OF BRIGHTNESS

intuitive evaluations of outcomes are also reference-dependent.

The role of prior stimulation is familiar in the domain of temperature. Immersing the hand in water at 20°C will feel pleasantly warm after prolonged immersion in much colder water, and pleasantly cool after immersion in much warmer water. Figure 5 illustrates reference-dependence in vision. The two enclosed squares have the same luminance, but they do not appear equally bright. The point of the demonstration is that the brightness of an area is not a single-parameter function of the light energy that reaches the eye from that area, just as the experience of temperature is not a single-parameter function of the temperature to which one is currently exposed. An account of perceived brightness or temperature also requires a parameter for a reference value (often called adaptation level), which is influenced by the context of current and prior stimulation.

From the vantage point of a student of perception, it is quite surprising that in standard economic analyses the utility of decision outcomes is assumed to be determined entirely by the final state of endowment, and is therefore reference-independent. In the context of risky choice, this assumption can be traced to the brilliant essay that first defined a theory of expected utility (Daniel Bernoulli, 1738). Bernoulli assumed that states of wealth have a specified utility, and proposed that the decision rule for choice under risk is to maximize the expected utility of wealth (the moral expectation). The language of Bernoulli's essay is prescriptive—it speaks of what is sensible or reasonable to do—but the theory was also intended as a description of the choices of reasonable men (Gerd Gigerenzer et al., 1989). As in most modern treatments of decision-making, Bernoulli's essay does not acknowledge any tension between prescription and description. The proposition that decision makers evaluate outcomes by the utility of final asset positions has been retained in economic analyses for almost 300 years. This is rather remarkable, because the idea is easily shown to be wrong; I call it Bernoulli's error.

Tversky and I constructed numerous thought experiments when we began the study of risky choice that led to the formulation of prospect theory (Kahneman and Tversky, 1979). Examples such as Problems 1 and 2 below convinced us of the inadequacy of the utility function for wealth as an explanation of choice.

Problem 1
Would you accept this gamble?

50% chance to win $150
50% chance to lose $100

Would your choice change if your overall wealth were lower by $100?

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There will be few takers of the gamble in Problem 1. The experimental evidence shows that most people will reject a gamble with even chances to win and lose, unless the possible win is at least twice the size of the possible loss (e.g., Tversky and Kahneman, 1992). The answer to the second question is, of course, negative. Next consider Problem 2:

> Problem 2
> Which would you choose?
> *lose $100 with certainty*
> or
> *50% chance to win $50*
> *50% chance to lose $200*
>
> Would your choice change if your overall wealth were higher by $100?

In Problem 2, the gamble appears much more attractive than the sure loss. Experimental results indicate that risk-seeking preferences are held by a large majority of respondents in problems of this kind (Kahneman and Tversky, 1979). Here again, the idea that a change of $100 in total wealth would affect preferences cannot be taken seriously.

We examined many choice pairs of this type in our early explorations, and concluded that the very abrupt switch from risk aversion to risk seeking could not plausibly be explained by a utility function for wealth. Preferences appeared to be determined by attitudes to gains and losses, defined relative to a reference point, but Bernoulli's theory and its successors did not incorporate a reference point. We therefore proposed an alternative theory of risk, in which the carriers of utility are gains and losses—changes of wealth rather than states of wealth. One novelty of prospect theory was that it was explicitly presented as a formal descriptive theory of the choices that people actually make, not as a normative model. This was a departure from a long history of choice models that served double duty as normative logics and as idealized descriptive models.

The distinctive predictions of prospect theory follow from the shape of the value function, which is shown in Figure 6. The value function is defined on gains and losses and is

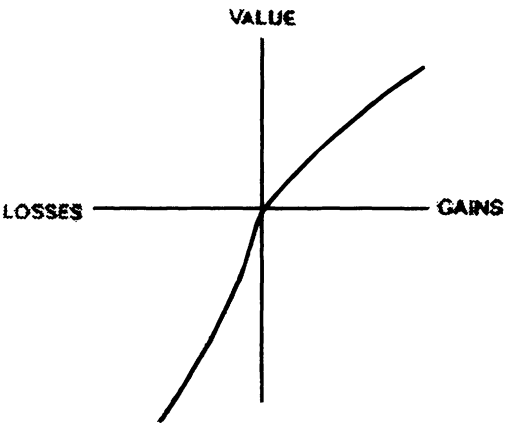

FIGURE 6. A SCHEMATIC VALUE FUNCTION FOR CHANGES

characterized by three features: (1) it is concave in the domain of gains, favoring risk aversion; (2) it is convex in the domain of losses, favoring risk seeking; (3) most important, the function is sharply kinked at the reference point, and *loss-averse*—steeper for losses than for gains by a factor of about 2–2.5 (Kahneman et al., 1991; Tversky and Kahneman, 1992).

If Bernoulli's formulation is transparently incorrect as a descriptive model of risky choices, as has been argued here, why has this model been retained for so long? The answer appears to be that the assignment of utility to wealth is an aspect of rationality, and therefore compatible with the general assumption of rationality in economic theorizing (Kahneman, 2003a). Consider Problem 3:

> Problem 3
> *Two persons get their monthly report from a broker:*
> *A is told that her wealth went from 4M to 3M*
> *B is told that her wealth went from 1M to 1.1M*
>
> Who of the two individuals has more reason to be satisfied with her financial situation?
>
> Who is happier today?

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Problem 3 highlights the contrasting interpretations of utility in theories that define outcomes as states or as changes. In Bernoulli's analysis only the first of the two questions of Problem 3 is relevant, and only long-term consequences matter. Prospect theory, in contrast, is concerned with short-term outcomes, and the value function presumably reflects an anticipation of the valence and intensity of the emotions that will be experienced at moments of transition from one state to another (Kahneman, 2000a, b; Barbara Mellers, 2000). Which of these concepts of utility is more useful? The cultural norm of reasonable decision-making favors the long-term view over a concern with transient emotions. Indeed, the adoption of a broad perspective and a long-term view is an aspect of the meaning of rationality in everyday language. The final-states interpretation of the utility of outcomes is therefore a good fit for a rational-agent model.

These considerations support the normative and prescriptive status of the Bernoullian definition of outcomes. On the other hand, an exclusive concern with the long term may be prescriptively sterile, because the long term is not where life is lived. Utility cannot be divorced from emotion, and emotions are triggered by changes. A theory of choice that completely ignores feelings such as the pain of losses and the regret of mistakes is not only descriptively unrealistic, it also leads to prescriptions that do not maximize the utility of outcomes as they are actually experienced—that is, utility as Bentham conceived it (Kahneman, 1994, 2000a; Kahneman et al., 1997).

Bernoulli's error—the idea that the carriers of utility are final states—is not restricted to decision-making under risk. Indeed, the incorrect assumption that initial endowments do not matter is the basis of Coase's theorem and of its multiple applications (Kahneman et al., 1990). The error of reference-independence is built into the standard representation of indifference maps. It is puzzling to a psychologist that these maps do not include a representation of the decision maker's current holdings of various goods—the counterpart of the reference point in prospect theory. The parameter is not included, of course, because consumer theory assumes that it does not matter.

The core idea of prospect theory—that the value function is kinked at the reference point and loss averse—became useful to economics when Thaler (1980) used it to explain riskless choices. In particular, loss aversion explained a violation of consumer theory that Thaler identified and labeled the "endowment effect": the selling price for consumption goods is much higher than the buying price, often by a factor of 2 or more. The value of a good to an individual appears to be higher when the good is viewed as something that could be lost or given up than when the same good is evaluated as a potential gain (Kahneman et al., 1990, 1991; Tversky and Kahneman, 1991).

When half the participants in an experimental market were randomly chosen to be endowed with a good (a mug) and trade was allowed, the volume of trade was about half the amount that would be predicted by assuming that value was independent of initial endowment (Kahneman et al., 1990). Transaction costs did not explain this counterexample to the Coase theorem, because the same institution produced no indication of reluctance to trade when the objects of trade were money tokens. The results suggest that the participants in these experiments did not value the mug as an object they could have and consume, but as something they could get, or give up. Interestingly, John A. List (2003a, b) found that the magnitude of the endowment effect was substantially reduced for participants with intense experience in the trading of sports-cards. Experienced traders (who are also consumers) showed less reluctance to trade one good for another—not only sportscards, but also mugs and other goods—as if they had learned to base their choice on long-term value, rather than on the immediate emotions associated with getting or giving up objects.

Reference-dependence and loss aversion help account for several phenomena of choice. The familiar observation that out-of-pocket losses are valued much more than opportunity costs is readily explained, if these outcomes are evaluated on different limbs of the value function. The distinction between "actual" losses and losses of opportunities is recognized in many ways in the law (David Cohen and Jack L. Knetsch, 1992) and in lay intuitions about rules of fairness in the market (Kahneman et al., 1986). Loss aversion also contributes to the well-documented status-quo bias (William Samuelson and Richard Zeckhauser, 1988). Because the reference point is usually the status quo, the properties of alternative options are evaluated as advantages or disadvantages

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relative to the current situation, and the disadvantages of the alternatives loom larger than their advantages. Other applications of the concept of loss aversion are documented in several chapters in Kahneman and Tversky (2000).

IV. Framing Effects

In the display of blocks in Figure 2, the same property (the total height of a set of blocks) was highly accessible in one display and not in another, although both displays contained the same information. This observation is entirely unremarkable—it does not seem shocking that some attributes of a stimulus are automatically perceived while others must be computed, or that the same attribute is perceived in one display of an object but must be computed in another. In the context of decision-making, however, similar observations raise a significant challenge to the rational-agent model.

The assumption that preferences are not affected by inconsequential variations in the description of outcomes has been called extensionality (Kenneth J. Arrow, 1982) and invariance (Tversky and Kahneman, 1986), and is considered an essential aspect of rationality. Invariance is violated in *framing effects*, where extensionally equivalent descriptions lead to different choices by altering the relative salience of different aspects of the problem. Tversky and Kahneman (1981) introduced their discussion of framing effects with the following problem:

> The Asian disease
>
> *Imagine that the United States is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows:*
>
> *If Program A is adopted, 200 people will be saved*
>
> *If Program B is adopted, there is a one-third probability that 600 people will be saved and a two-thirds probability that no people will be saved*

In this version of the problem, a substantial majority of respondents favor Program A, indicating risk aversion. Other respondents, selected at random, receive a question in which the same cover story is followed by a different description of the options:

> *If Program A′ is adopted, 400 people will die*
>
> *If Program B′ is adopted, there is a one-third probability that nobody will die and a two-thirds probability that 600 people will die*

A substantial majority of respondents now favor Program B′, the risk-seeking option. Although there is no substantive difference between the versions, they evoke different associations and evaluations. This is easiest to see in the certain option, because outcomes that are certain are overweighted relative to outcomes of high or intermediate probability (Kahneman and Tversky, 1979). Thus, the certainty of saving people is disproportionately attractive, while accepting the certain death of people is disproportionately aversive. These immediate affective responses respectively favor A over B and B′ over A′. As in Figures 2a and 2b, the different representations of the outcomes highlight some features of the situation and mask others.

In an essay about the ethics of policy, Thomas C. Schelling (1984) presented a compellingly realistic example of the dilemmas raised by framing. Schelling reports asking his students to evaluate a tax policy that would allow a larger child exemption to the rich than to the poor. Not surprisingly, his students found this proposal outrageous. Schelling then pointed out that the default case in the standard tax table is a childless family, with special adjustments for families with children, and led his class to agree that the existing tax schedule could be rewritten with a family with two children as the default case. In this formulation, childless families would pay a surcharge. Should this surcharge be as large for the poor as for the rich? Of course not. The two versions of the question about how to treat the rich and the poor both trigger an intuitive preference for protecting the

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poor, but these preferences are incoherent. Schelling's problem highlights an important point. Framing effects are not a laboratory curiosity, but a ubiquitous reality. The tax table must be framed one way or another, and each frame will increase the accessibility of some responses and make other responses less likely.

There has been considerable interest among behavioral economists in a particular type of framing effect, where a choice between two options A and B is affected by designating either A or B as a default option. The option designated as the default has a large advantage in such choices, even for decisions that have considerable significance. Eric J. Johnson et al. (1993) described a compelling example. The states of Pennsylvania and New Jersey both offer drivers a choice between an insurance policy that allows an unconstrained right to sue, and a less expensive policy that restricts the right to sue. The unconstrained right to sue is the default in Pennsylvania, the opposite is the default in New Jersey, and the takeup of full coverage is 79 percent and 30 percent in the two states, respectively. Johnson and Daniel G. Goldstein (2003) estimate that Pennsylvania drivers spend 450 million dollars annually on full coverage that they would not purchase if their choice were framed as it is for New Jersey drivers.

Johnson and Goldstein (2003) also compared the proportions of the population enrolled in organ donation programs in seven European countries in which enrollment was the default and four in which nonenrollment was the default. Averaging over countries, enrollment in donor programs was 97.4 percent when this was the default option, 18 percent otherwise. The passive acceptance of the formulation given has significant consequences in this case, as it does in other recent studies where the selection of the default on the form that workers completed to set their 401(k) contributions dominated their ultimate choice (Brigitte Madrian and Dennis Shea, 2001; James J. Choi et al., 2002).

The basic principle of framing is the passive acceptance of the formulation given. Because of this passivity, people fail to construct a canonical representation for all extensionally equivalent descriptions of a state of affairs. They do not spontaneously compute the height of a tower that could be built from an array of blocks, and they do not spontaneously transform the representation of puzzles or decision problems. Obviously, no one is able to recognize "137 × 24" and "3,288" as "the same" number without going through some elaborate computations. Invariance cannot be achieved by a finite mind.

The impossibility of invariance raises significant doubts about the descriptive realism of rational-choice models (Tversky and Kahneman, 1986). Absent a system that reliably generates appropriate canonical representations, intuitive decisions will be shaped by the factors that determine the accessibility of different features of the situation. Highly accessible features will influence decisions, while features of low accessibility will be largely ignored—and the correlation between accessibility and reflective judgments of relevance in a state of complete information is not necessarily high.

A particularly unrealistic assumption of the rational-agent model is that agents make their choices in a comprehensively inclusive context, which incorporates all the relevant details of the present situation, as well as expectations about all future opportunities and risks. Much evidence supports the contrasting claim that people's views of decisions and outcomes are normally characterized by "narrow framing" (Kahneman and Daniel Lovallo, 1993), and by the related notions of "mental accounting" (Thaler, 1985, 1999) and "decision bracketing" (Daniel Read et al., 1999).

The following are some examples of the prevalence of narrow framing. The decision of whether or not to accept a gamble is normally considered as a response to a single opportunity, not as an occasion to apply a general policy (Gideon Keren and Willem A. Wagenaar, 1987; Tversky and Donald A. Redelmeier, 1992; Kahneman and Lovallo, 1993; Shlomo Benartzi and Thaler, 1999). Investors' decisions about particular investments appear to be considered in isolation from the remainder of the investor's portfolio (Nicholas Barberis et al., 2003). The time horizon that investors adopt for evaluating their investments appears to be unreasonably short—an observation that helps explain the equity-premium puzzle (Benartzi and Thaler, 1995). Finally, the prevalence of the gain/loss framing of outcomes over the wealth frame, which was discussed in the previous section, can now be seen as an instance of narrow

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framing. A shared feature of all these examples is that decisions made in narrow frames depart far more from risk neutrality than decisions that are made in a more inclusive context.

The prevalence of narrow frames is an effect of accessibility, which can be understood by referring to the displays of blocks in Figure 2. The same set of blocks is framed as a tower in Figure 2a, and as a flat array in Figure 2b. Although it is possible to "see" a tower in Figure 2b, it is much easier to do so in Figure 2a. Narrow frames generally reflect the structure of the environment in which decisions are made. The choices that people face arise one at a time, and the principle of passive acceptance suggests that they will be considered as they arise. The problem at hand and the immediate consequences of the choice will be far more accessible than all other considerations, and as a result decision problems will be framed far more narrowly than the rational model assumes.

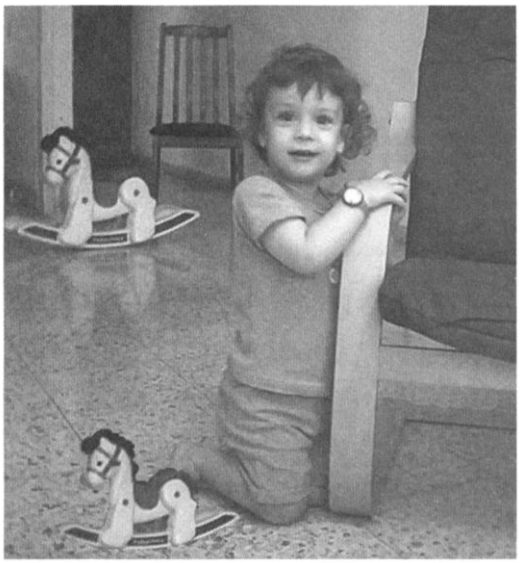

FIGURE 7. AN ILLUSION OF ATTRIBUTE SUBSTITUTION

Source: Photo by Lenore Shoham, 2003.

V. Attribute Substitution: A Model of Judgment Heuristics

The first research program that Tversky and I undertook together consisted of a series of studies of various types of judgment about uncertain events, including numerical predictions and assessments of the probabilities of hypotheses. Our conclusion in a review of this work was that "people rely on a limited number of heuristic principles which reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations. In general, these heuristics are quite useful, but sometimes they lead to severe and systematic errors" (Tversky and Kahneman, 1974, p. 1124). The article introduced three heuristics—representativeness, availability, and anchoring—that were used to explain a dozen systematic biases in judgment under uncertainty, including nonregressive prediction, neglect of base-rate information, overconfidence, and overestimates of the frequency of events that are easy to recall. Some of the biases were identified by systematic errors in estimates of known quantities and statistical facts. Other biases were defined by discrepancies between the regularities of intuitive judgments and the principles of probability theory, Bayesian inference, and regression analysis.

Kahneman and Frederick (2002) recently revisited the early studies of judgment heuristics, and proposed a formulation in which the reduction of complex tasks to simpler operations is achieved by an operation of *attribute substitution*. "Judgment is said to be mediated by a heuristic when the individual assesses a specified *target attribute* of a judgment object by substituting another property of that object—the *heuristic attribute*—which comes more readily to mind" (p. 53). Unlike the early work, Kahneman and Frederick's conception of heuristics is not restricted to the domain of judgment under uncertainty.

For a perceptual example of attribute substitution, consider the question: "What are the sizes of the two horses in Figure 7, as they are drawn on the page?" The images are in fact identical in size, but the figure produces a compelling illusion. The target attribute that observers intend to evaluate is objective two-dimensional size, but they are unable to do this veridically. Their judgments map an impression of three-dimensional size (the heuristic attribute) onto units of length that are appropriate to the target attribute, and scaled to the size of the page. This illusion is caused by the differential accessibility of competing interpretations of the image. An impression of three-

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dimensional size is the only impression of size that comes to mind for naïve observers—painters and experienced photographers are able to do better—and it produces an illusion in the perception of picture size.

A study by Fritz Strack et al. (1988) illustrates the role of attribute substitution in a different context. College students responded to a survey which included the two following questions in immediate succession: "How happy are you with your life in general?" and "How many dates did you have last month?" The correlation between the two questions was 0.12 when they appeared in the order shown. Among respondents who received the same questions in reverse order, the correlation was 0.66. The psychological interpretation of the high correlation[1] is inferential, but straightforward. The dating question undoubtedly evoked in many respondents an emotionally charged evaluation of their romantic life. This evaluation was highly accessible when the question about happiness was encountered next, and it was mapped onto the scale of general happiness. In the interpretation offered here, the respondents answered the happiness question by reporting what came to their mind, and failed to notice that they were answering a question that had not been asked—a cognitive illusion that is analogous to the visual illusion of Figure 7.

The most direct evidence for attribute substitution was reported by Kahneman and Tversky (1973), in a task of categorical prediction. There were three experimental groups in their experiment. Participants in a ***base-rate*** group evaluated the relative frequencies of graduate students in nine categories of specialization.[2] Mean estimates ranged from 20 percent for Humanities and Education to 3 percent for Library Science.

Two other groups of participants were shown the same list of areas of graduate specialization, and the following description of a fictitious graduate student.

> *Tom W. is of high intelligence, although lacking in true creativity. He has a need for order and clarity, and for neat and tidy systems in which every detail finds its appropriate place. His writing is rather dull and mechanical, occasionally enlivened by somewhat corny puns and by flashes of imagination of the sci-fi type. He has a strong drive for competence. He seems to have little feel and little sympathy for other people and does not enjoy interacting with others. Self-centered, he nonetheless has a deep moral sense.*

Participants in a ***similarity*** group ranked the nine fields by the degree to which Tom W. "resembles a typical graduate student" (in that field). The description of Tom W. was deliberately constructed to make him more representative of the less populated fields, and this manipulation was successful: the correlation between the averages of representativeness rankings and of estimated base rates was −0.62. Participants in the ***probability*** group ranked the nine fields according to the likelihood that Tom W. would have specialized in each. The respondents in the latter group were graduate students in psychology at major universities. They were told that the personality sketch had been written by a psychologist when Tom W. was in high school, on the basis of personality tests of dubious validity. This information was intended to discredit the description as a source of valid information.

The statistical logic is straightforward. A description based on unreliable information must be given little weight, and predictions made in the absence of valid evidence must revert to base rates. This reasoning implies that judgments of probability should be highly correlated with the corresponding base rates in the Tom W. problem.

The psychology of the task is also straightforward. The similarity of Tom W. to various stereotypes is a highly accessible natural assessment, whereas judgments of probability are difficult. The respondents are therefore expected to substitute a judgment of similarity (representativeness) for the required judgment of probability. The two instructions—to rate similarity or

[1] The observed value of 0.66 underestimates the true correlation between the variables of interest, because of measurement error in all variables.

[2] The categories were Business Administration; Computer Science; Engineering; Humanities and Education; Law; Library Science; Medicine; Physical and Life Sciences; Social Sciences and Social Work.

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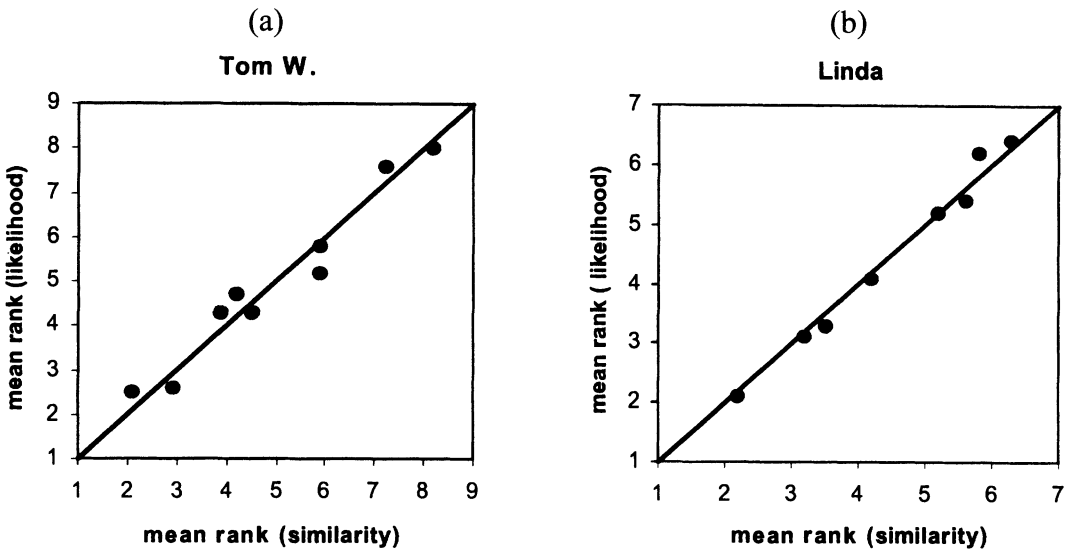

FIGURE 8. TWO TESTS OF ATTRIBUTE SUBSTITUTION IN A PREDICTION TASK

probability—should therefore elicit similar judgments.

The scatterplot of the mean judgments of the two groups is presented in Figure 8a. As the figure shows, the correlation between judgments of probability and similarity is nearly perfect (0.98). The correlation between judgments of probability and base rates is −0.63. The results are in perfect accord with the hypothesis of attribute substitution. They also confirm a bias of *base-rate neglect* in this prediction task. The results are especially compelling because the responses were rankings. The large variability of the average rankings of both attributes indicates highly consensual responses, and nearly total overlap in the systematic variance.

Figure 8b shows the results of another study in the same design, in which respondents were shown the description of a woman named Linda, and a list of eight possible outcomes describing her present employment and activities. The two critical items in the list were #6 ("Linda is a bank teller") and the conjunction item #8 ("Linda is a bank teller and active in the feminist movement"). The other six possibilities were unrelated and miscellaneous (e.g., elementary school teacher, psychiatric social worker). As in the Tom W. problem, some respondents ranked the eight outcomes by the similarity of Linda to the category prototypes; others ranked the same outcomes by probability.

> *Linda is 31 years old, single, outspoken and very bright. She majored in philosophy. As a student she was deeply concerned with issues of discrimination and social justice and also participated in antinuclear demonstrations.*

As might be expected, 85 percent of respondents in the similarity group ranked the conjunction item (#8) higher than its constituent, indicating that Linda resembles the image of a feminist bank teller more than she resembles a stereotypical bank teller. This ordering of the two items is quite reasonable for judgments of similarity. However, it is much more problematic that 89 percent of respondents in the probability group also ranked the conjunction higher than its constituent. This pattern of probability judgments violates monotonicity, and has been called the "conjunction fallacy" (Tversky and Kahneman, 1983).

The observation that biases of judgment are systematic was quickly recognized as relevant to the debate about the assumption of rationality

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in economics (see, e.g., Peter A. Diamond, 1977; David M. Grether, 1978; Howard Kunreuther, 1979; Arrow, 1982). There has also been some discussion of the role of specific judgment biases in economic phenomena, especially in finance (e.g., Werner F. M. De Bondt and Thaler, 1985; Robert J. Shiller, 2000; Andrei Shleifer, 2000; Matthew Rabin, 2002). Recent extensions of the notion of heuristics to the domain of affect may be of particular relevance to the conversation between psychology and economics, because they bear on the core concept of a preference. As was noted earlier, affective valence is a natural assessment, which is automatically computed and always accessible. This basic evaluative attribute (good/bad, like/dislike, approach/avoid) is therefore a candidate for substitution in any task that calls for a favorable or unfavorable response. Slovic and his colleagues (see, e.g., Slovic et al., 2002) introduced the concept of an *affect heuristic.* They showed that affect (liking or disliking) is the heuristic attribute for numerous target attributes, including the evaluation of the costs and benefits of various technologies, the safe concentration of chemicals, and even the predicted economic performance of various industries. In an article aptly titled "Risk as Feelings," Loewenstein et al. (2001) documented the related proposition that beliefs about risk are often expressions of emotion.

If different target attributes are strongly influenced by the same affective reaction, the dimensionality of decisions and judgments about valued objects may be expected to be unreasonably low. Indeed, Melissa L. Finucane et al. (2000) found that people's judgments of the costs and benefits of various technologies are *negatively* correlated, especially when the judgments are made under time pressure. A technology that is liked is judged to have low costs and large benefits. These judgments are surely biased, because the correlation between costs and benefits is generally positive in the world of real choices. In the same vein, Kahneman et al. (1997) presented evidence that different responses to public goods (e.g., willingness to pay, ratings of moral satisfaction for contributing) yielded essentially interchangeable rankings of a set of policy issues. Here again, a basic affective response appeared to be the common factor.

Kahneman et al. (1997) suggested that people's decisions often express affective evaluations (attitudes), which do not conform to the logic of economic preferences. To understand preferences, then, we may need to understand the psychology of emotions. And we cannot take it for granted that preferences that are controlled by the emotion of the moment will be internally coherent, or even reasonable by the cooler criteria of reflective reasoning. In other words, the preferences of System 1 are not necessarily consistent with the preferences of System 2. The next section will show that some choices are not appropriately sensitive to variations of quantity and cost—and are better described as expressions of an affective response than as economic preferences.

VI. Prototype Heuristics

The results summarized in Figure 8 showed that the judgments that subjects made about the Tom W. and Linda problems substituted the more accessible attribute of similarity (representativeness) for the required target attribute of probability. The goal of the present section is to embed the representativeness heuristic in a broader class of *prototype heuristics,* which share a common psychological mechanism—the representation of categories by their prototypes—and a remarkably consistent pattern of biases.

In the display of lines in Figure 3, the average (typical) length of the lines was highly accessible, but the sum of their lengths was not. Both observations are quite general. Classic psychological experiments have established the following proposition: whenever we look at or think about a set (ensemble, category) which is sufficiently homogeneous to have a prototype, information about the prototype is automatically accessible (Michael I. Posner and Stephen W. Keele, 1968; Eleanor Rosch and Carolyn B. Mervis, 1975). The prototype of a set is characterized by the average values of the salient properties of its members. The high accessibility of prototype information serves an important adaptive function. It allows new stimuli to be categorized efficiently, by comparing their features to those of category prototypes.[3] For

[3] Stored information about individual exemplars also contributes to categorization.

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example, the stored prototype of a set of lines allows a quick decision about a new line—does it belong with the set? There is no equally obvious function for the automatic computation of sums.

The low accessibility of sums and the high accessibility of prototypes have significant consequences in tasks that involve judgments of sets, as in the following examples:

(i) category prediction (e.g., *the probability that the category of bank tellers contains Linda as a member*);
(ii) pricing a quantity of public or private goods (e.g., *the personal dollar value of saving a certain number of migratory birds from drowning in oil ponds*);
(iii) global evaluation of a past experience that extended over time (e.g., *the overall aversiveness of a painful medical procedure*);
(iv) assessment of the support that a sample of observations provides for a hypothesis (e.g., *the probability that a sample of colored balls has been drawn from one specified urn rather than another*).

The objects of judgment in these tasks are sets or categories, and the target attributes have a common logical structure. *Extensional attributes* are governed by a general principle of conditional adding, which dictates that each element within the set adds to the overall value an amount that depends on the elements already included. In simple cases, the value is additive: the total length of the set of lines in Figure 3 is just the sum of their separate lengths. In other cases, each positive element of the set increases the aggregate value, but the combination rule is nonadditive (typically subadditive).[4] The attributes of the category prototype are not extensional—they are averages, whereas extensional attributes are akin to sums.

The preceding argument leads to the hypothesis that tasks that require the assessment of extensional variables will be relatively difficult, and that intuitive responses may be generated by substituting an attribute of the prototype for the extensional target attribute. Prototype heuristics involve a target attribute that is extensional, and a heuristic attribute which is a characteristic of the category prototype. Prototype heuristics are associated with two major biases, which generalize the biases of representativeness that were introduced in the preceding section:

(i) *Violations of monotonicity.* Adding elements to a set may lower the average and cause the judgment of the target variable to decrease, contrary to the logic of extensional variables. The prevalent judgment that Linda is less likely to be a bank teller than to be a feminist bank teller illustrates this bias.
(ii) *Extension neglect.* Other things equal, an increase in the extension of a category will increase the value of its extensional attributes, but leave unchanged the values of its prototype attributes. The apparent neglect of the base rates of areas of specialization in judgments about Tom W. is an example.

Studies that have examined the two biases in different contexts are described next.

A. *Pricing Goods*

The price of a set of goods is an extensional variable. If price is evaluated by the attractiveness of a prototypical element of the set, violations of monotonicity and extension neglect are predicted.

Scope Neglect.—Complete or almost complete neglect of extension has often been observed in studies of the willingness to pay for public goods, where the effect is called "neglect of scope." The best known example is a study by William H. Desvousges et al. (1993) in which respondents indicated their willingness to contribute money to prevent the drowning of migratory birds. The number of birds that would be saved was varied for different subsamples. The estimated amounts that households were willing to pay were $80, $78, and $88, to save 2,000, 20,000, or 200,000 birds, respectively.

[4] If the judgment is monotonically related to an additive scale (such as the underlying count of the number of birds), the formal structure is known in the measurement literature as an "extensive structure" (R. Duncan Luce et al., 1990, Ch. 3). There also may be attributes that lack an underlying additive scale, in which case the structure is known in the literature as a "positive concatenation structure" (Luce et al., 1990, Ch. 19, volume 3, p. 38).

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The target attribute in this case is willingness to pay (WTP), and the heuristic attribute appears to be the emotion associated with the image of a bird drowning in oil, or perhaps with the image of a bird being saved from drowning (Kahneman et al., 1999).

Frederick and Baruch Fischhoff (1998) reviewed numerous demonstrations of such *scope neglect* in studies of willingness to pay for public goods. For example, Kahneman and Knetsch found that survey respondents in Toronto were willing to pay almost as much to clean up the lakes in a small region of Ontario or to clean up all the lakes in that province (reported by Kahneman, 1986). The issue of scope neglect is central to the application of the contingent valuation method (CVM) in the assessment of the economic value of public goods, and it has been hotly debated (see, e.g., Richard T. Carson, 1997). The proponents of CVM have reported experiments in which there was some sensitivity to scope, but even these effects are minute, far too small to satisfy the economic logic of pricing (Diamond, 1996; Kahneman et al., 1999).

Violations of Monotonicity.—List (2002) reported an experiment that confirmed, in a real market setting, violations of dominance that Hsee (1998) had previously reported in a hypothetical pricing task. In List's experiment, traders of sportscards assigned significantly higher value to a set of ten sportscards labeled "Mint/near mint condition" than to a set that included the same ten cards and three additional cards described as "poor condition." In a series of follow-up experiments, Jonathan E. Alevy et al. (2003) also confirmed an important difference (originally suggested by Hsee) between the prices that people will pay when they see only one of the goods (separate evaluation), or when they price both goods at the same time (joint evaluation). The goods were similar to those used in List's experiment. The predicted violation of dominance was observed in separate evaluation, especially for relatively inexperienced market participants. These individuals bid an average of $4.05 for the small set of cards, and only $1.82 for the larger set. The violations of dominance were completely eliminated in the joint evaluation condition, where the bids for the small and large sets averaged $2.89 and $3.32, respectively. Alevy et al. (2003) noted that System 1 appears to dominate responses in separate evaluation, whereas System 2 conforms to the dominance rule when given a chance to do so. There was a definite effect of market experience, both in this study and in List (2002): the bids of highly experienced traders also showed violations of monotonicity in separate evaluation, but the effect was much smaller.

B. *Evaluations of Extended Episodes*

The global utility of an experience that extends over time is an extensional attribute (Kahneman, 1994, 2000a, b; Kahneman et al., 1997), and the duration of the experience is a measure of its extension. The corresponding prototype attribute is the experienced utility associated with a representative moment of the episode. As predicted by attribute substitution, global evaluations of the episode exhibit both duration neglect and violations of monotonicity.

Duration Neglect.—In a study described by Redelmeier and Kahneman (1996), patients undergoing colonoscopy reported the intensity of pain every 60 seconds during the procedure (see Figure 9), and subsequently provided a global evaluation of the pain they had suffered. The correlation of global evaluations with the duration of the procedure (which ranged from 4 to 66 minutes in that study) was 0.03. On the other hand global evaluations were correlated (r = 0.67) with an average of the pain reported at two points of time: when pain was at its peak, and just before the procedure ended. For example, patient A in Figure 9 reported a more negative evaluation of the procedure than patient B. The same pattern of *duration neglect* and Peak/End evaluations has been observed in other studies (Barbara L. Fredrickson and Kahneman, 1993; see Kahneman, 2000a, for a discussion). These results are consistent with the hypothesis that the extended episode (which can be considered an ordered set of moments) is represented in memory by a typical moment of the experience.

Violations of Dominance.—A randomized clinical experiment was conducted following the colonoscopy study described above. For half the patients, the instrument was not immediately removed when the clinical examination

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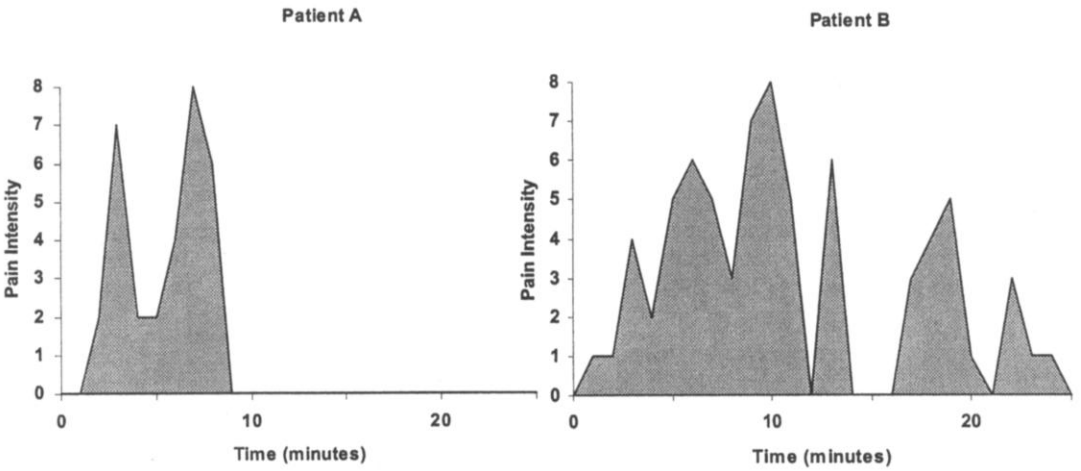

FIGURE 9. PAIN INTENSITY REPORTED BY TWO COLONOSCOPY PATIENTS

ended. Instead, the physician waited for about a minute, leaving the instrument stationary. The experience during the extra period was uncomfortable, but the procedure guaranteed that the colonoscopy never ended in severe pain. Patients reported significantly more favorable global evaluations in this experimental condition than in the control condition (Redelmeier et al., 2003).

Violations of dominance have also been confirmed in choices. Kahneman et al. (1993) exposed participants to two cold-pressor experiences, one with each hand: a "short" episode (immersion of one hand in 14°C water for 60 seconds), and a "long" episode (the short episode, plus an additional 30 seconds during which the water was gradually warmed to 15°C). When they were later asked which of the two experiences they preferred to repeat, a substantial majority chose the long trial. This pattern of choices is predicted from the Peak/End rule of evaluation that was described earlier. Similar violations of dominance were observed with unpleasant sounds of variable loudness and duration (Charles A. Schreiber and Kahneman, 2000). These violations of dominance suggest that choices between familiar experiences are made in an intuitive process of "choosing by liking." Extended episodes are represented in memory by a typical moment—and the desirability or aversiveness of the episode is dominated by the remembered utility of that moment (Kahneman, 1994). When a choice is to be made, the option that is associated with the higher remembered utility (more liked) is chosen. This mode of choice is likely to yield choices that do not maximize the utility that will actually be experienced (Kahneman et al., 1997).

C. *Other Prototype Heuristics*

The pattern of results observed in diverse studies of prototype heuristics suggests the need for a unified interpretation, and raises a significant challenge to treatments that deal only with one domain. A number of authors have offered competing interpretations of base-rate neglect (Leda Cosmides and John Tooby, 1996; Jonathan Jay Koehler, 1996), insensitivity to scope in WTP (Raymond Kopp, 1992), and duration neglect (Ariely and Loewenstein, 2000). In general however, these interpretations are specific to a particular task, and would not carry over to demonstrations of extension neglect in the other tasks that have been discussed. In contrast, the account offered here (and developed in greater detail by Kahneman and Frederick, 2002) is equally applicable to diverse tasks that require an assessment of an extensional target attribute.

The cases that have been discussed are only illustrations, not a comprehensive list of prototype heuristics. For example, the same form of nonextensional thinking explains why the me-

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dian estimate of the annual number of murders in Detroit is twice as high as the estimate of the number of murders in Michigan (Kahneman and Frederick, 2002). It also explains why professional forecasters assigned a higher probability to "an earthquake in California causing a flood in which more than 1,000 people will drown" than to "a flood somewhere in the United States in which more than 1,000 people will drown" (Tversky and Kahneman, 1983).

As these examples illustrate, there is no guaranteed defense against violations of monotonicity. How could a forecaster who assigns a probability to a lethal flood ensure (in finite time) that there is no subset of that event which would have appeared even more probable? More generally, the results reviewed in this section suggest a profound incompatibility between the capabilities and operational rules of intuitive judgment and choice and the normative standards for beliefs and preferences. The logic of belief and choice requires accurate evaluation of extensional variables. In contrast, intuitive thinking operates with exemplars or prototypes that have the dimensionality of individual instances and lack the dimension of extension.

VII. The Boundaries of Intuitive Thinking

The judgments that people express, the actions they take, and the mistakes they commit depend on the monitoring and corrective functions of System 2, as well as on the impressions and tendencies generated by System 1. This section reviews a selection of findings and ideas about the functioning of System 2. A more detailed treatment is given in Kahneman and Frederick (2002) and Kahneman (2003b).

Judgments and choices are normally intuitive, skilled, unproblematic, and reasonably successful (Klein, 1998). The prevalence of framing effects, and other indications of superficial processing such as the bat-and-ball problem, suggest that people mostly do not think very hard and that System 2 monitors judgments quite lightly. On some occasions, however, the monitoring of System 2 will detect a potential error, and an effort will be made to correct it. The question for this section can be formulated in terms of accessibility: when do doubts about one's intuitive judgments come to mind? The answer, as usual in psychology, is a list of relevant factors.

Research has established that the ability to avoid errors of intuitive judgment is impaired by time pressure (Finucane et al., 2000), by concurrent involvement in a different cognitive task (Gilbert, 1989, 1991, 2002), by performing the task in the evening for "morning people" and in the morning for "evening people" (Galen V. Bodenhausen, 1990), and, surprisingly, by being in a good mood (Alice M. Isen et al., 1988; Herbert Bless et al., 1996). Conversely, the facility of System 2 is positively correlated with intelligence (Stanovich and West, 2002), with the trait that psychologists have labeled "need for cognition" (which is roughly whether people find thinking fun) (Eldar Shafir and Robyn A. LeBoeuf, 2002), and with exposure to statistical thinking (Richard E. Nisbett et al., 1983; Franca Agnoli and David H. Krantz, 1989; Agnoli, 1991).

The question of the precise conditions under which errors of intuition are most likely to be prevented is of methodological interest to psychologists, because some controversies in the literature on cognitive illusions are resolved when this factor is considered (see Kahneman and Frederick, 2002; Kahneman, 2003b). One of these methodological issues is also of considerable substantive interest: this is the distinction between separate evaluation and joint evaluation (Hsee, 1996).

In the separate evaluation condition of List's study of dominance violations, for example, different groups of traders bid on two sets of baseball cards; in joint evaluation each trader evaluated both sets at the same time. The results were drastically different. Violations of monotonicity, which were very pronounced in the between-groups comparison, were eliminated in the joint evaluation condition. The participants in the latter condition evidently realized that one of the sets of goods included the other, and was therefore worth more. Once they had detected the dominance relation, the participants constrained their bids to follow the rule. These decisions are mediated by System 2. Thus, there appear to be two distinct modes of choice: "choosing by liking" selects the most attractive option; "choosing by rule" conforms to an explicit constraint.

Prospect theory introduced the same distinction between modes of choice (Kahneman and

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Tversky, 1979). The normal process corresponds to choice by liking: the decision maker evaluates each gamble in the choice set, then selects the gamble of highest value. In prospect theory, this mode of choice can lead to the selection of a dominated option.[5] However, the theory also introduced the possibility of choice by rule: if one option transparently dominates the other, the decision maker will select the dominant option without further evaluation. To test this model, Tversky and Kahneman (1986) constructed a pair of gambles that satisfied three criteria: (i) gamble A dominated gamble B; (ii) the prospect-theory value of B was higher than the value of A; (iii) the gambles were complex, and the dominance relation only became apparent after grouping outcomes. As expected from other framing results, most participants in the experiment evaluated the gambles as originally formulated, failed to detect the relation between them, chose the option they liked most, and exhibited the predicted violation of dominance.

The cold-pressor experiment that was described earlier (Kahneman et al., 1993) is closely analogous to the study of nontransparent dominance that Tversky and Kahneman (1986) reported. A substantial majority of participants violated dominance in a direct and seemingly transparent choice between cold-pressor experiences. However, postexperimental debriefings indicated that the dominance was not in fact transparent. The participants in the experiment did not realize that the long episode included the short one, although they did notice that the episodes differed in duration. Because they failed to detect that one option dominated the other, the majority of participants chose as people commonly do when they select an experience to be repeated: they "chose by liking," selected the option that had the higher remembered utility, and thereby agreed to expose themselves to a period of unnecessary pain (Kahneman, 1994; Kahneman et al., 1997).

The complex pattern of results in the studies of dominance in the joint-evaluation design suggests three general conclusions: (i) choices that are governed by rational rules do exist, but (ii) these choices are restricted to unusual circumstances, and (iii) the activation of the rules depends on the factors of attention and accessibility. The fact that System 2 "knows" the dominance rule and "wants" to obey it only guarantees that the rule will be followed if a potential violation is explicitly detected.

System 2 has the capability of correcting other errors, besides violations of dominance. In particular, the substitution of one attribute for another in judgment inevitably leads to errors in the weights assigned to different sources of information, and these could—at least in principle—be detected and corrected. For example, a participant in the Tom W. study (see Figure 8a) could have reasoned as follows: "Tom W. looks very much like a library science student, but there are very few of those. I should therefore adjust my impression of probability downward." Although this level of reasoning should not have been beyond the reach of the graduate students who answered the Tom W. question, the evidence shown in Figure 8 shows that few, if any, of these respondents had the idea of adjusting their predictions to allow for the different base rates of the alternative outcomes. The explanation of this result in terms of accessibility is straightforward: the experiment provided no explicit cues to the relevance of base rates.

Base-rate information was not completely ignored in experiments that provided stronger cues, though the effects of this variable were consistently too small relative to the effect of the case-specific information (Jonathan St. B. T. Evans et al., 2002). The evidence of numerous studies supports the following conclusions: (i) the likelihood that the subject will detect a misweighting of some aspect of the information depends on the salience of cues to the relevance of that factor; (ii) if the misweighting is detected, there will be an effort to correct it; (iii) the correction is likely to be insufficient, and the final judgments are therefore likely to remain anchored on the initial intuitive impression (Gretchen B. Chapman and Johnson, 2002).

Economists may be struck by the emphasis on salient cues and by the absence of financial incentives from the list of major factors that influence the quality of decisions and judgments. However, the claim that high stakes eliminate departures from rationality is not supported by a careful review of the experimental evidence (Camerer and Robin M. Hogarth, 1999). A growing literature of field research and

[5] Cumulative prospect theory (Tversky and Kahneman, 1992) does not have this feature.

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field experiments documents large and systematic mistakes in some of the most consequential financial decisions that people make, including choices of investments (Brad M. Barber and Terrance Odean, 2000; Benartzi and Thaler, 2001), and actions in the real estate market (David Genesove and Christopher J. Mayer, 2001). The daily paper provides further evidence of poor decisions with large outcomes.

The present analysis helps explain why the effects of incentives are neither large nor robust. High stakes surely increase the amount of attention and effort that people invest in their decisions. But attention and effort by themselves do not purchase rationality or guarantee good decisions. In particular, cognitive effort expended in bolstering a decision already made will not improve its quality, and the evidence suggests that the share of time and effort devoted to such bolstering may increase when the stakes are high (Jennifer S. Lerner and Philip E. Tetlock, 1999). Effort and concentration are likely to bring to mind a more complete set of considerations, but the expansion may yield an inferior decision unless the weighting of the secondary considerations is appropriately low. In some instances—including tasks that require predictions of one's future tastes—too much cognitive effort actually lowers the quality of performance (Wilson and Jonathan W. Schooler, 1991). Klein (2003, Ch. 4) has argued that there are other situations in which skilled decision makers do better when they trust their intuitions than when they engage in detailed analysis.

VIII. Concluding Remarks

The rational agent of economic theory would be described, in the language of the present treatment, as endowed with a single cognitive system that has the logical ability of a flawless System 2 and the low computing costs of System 1. Theories in behavioral economics have generally retained the basic architecture of the rational model, adding assumptions about cognitive limitations designed to account for specific anomalies. For example, the agent may be rational except for discounting hyperbolically, evaluating outcomes as changes, or a tendency to jump to conclusions.

The model of the agent that has been presented here has a different architecture, which may be more difficult to translate into the theoretical language of economics. The core ideas of the present treatment are the two-system structure, the large role of System 1 and the extreme context-dependence that is implied by the concept of accessibility. The central characteristic of agents is not that they reason poorly but that they often act intuitively. And the behavior of these agents is not guided by what they are able to compute, but by what they happen to see at a given moment.

These propositions suggest heuristic questions that may guide attempts to predict or explain behavior in a given setting: "What would an impulsive agent be tempted to do?" "What course of action seems most natural in this situation?" The answers to these questions will often identify the judgment or course of action to which most people will be attracted. For example, it is more natural to join a group of strangers running in a particular direction than to adopt a contrarian destination. However, the two-system view also suggests that other questions should be raised: "Is the intuitively attractive judgment or course of action in conflict with a rule that the agent would endorse?" If the answer to that question is positive, then "How likely is it in the situation at hand that the relevant rule will come to mind in time to override intuition?" Of course, this mode of analysis also allows for differences between individuals, and between groups. What is natural and intuitive in a given situation is not the same for everyone: different cultural experiences favor different intuitions about the meaning of situations, and new behaviors become intuitive as skills are acquired. Even when these complexities are taken into account, the approach to the understanding and prediction of behavior that has been sketched here is simple and easy to apply, and likely to yield hypotheses that are generally plausible and often surprising. The origins of this approach are in an important intellectual tradition in psychology, which has emphasized "the power of the situation" (Lee Ross and Nisbett, 1991).

The present treatment has developed several themes: that intuition and reasoning are alternative ways to solve problems, that intuition resembles perception, that people sometimes answer a difficult question by answering an easier one instead, that the processing of information is often superficial, that categories are

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represented by prototypes. All these features of the cognitive system were in our minds in some form when Amos Tversky and I began our joint work in 1969, and most of them were in Herbert Simon's mind much earlier. However, the role of emotion in judgment and decision making received less attention in that work than it had received before the beginning of the cognitive revolution in psychology in the 1950's. More recent developments have restored a central role to emotion, which is incorporated in the view of intuition that was presented here. Findings about the role of optimism in risk taking, the effects of emotion on decision weights, the role of fear in predictions of harm, and the role of liking and disliking in factual predictions—all indicate that the traditional separation between belief and preference in analyses of decision making is psychologically unrealistic.

Incorporating a common sense psychology of the intuitive agent into economic models will present difficult challenges, especially for formal theorists. It is encouraging to note, however, that the challenge of incorporating the first wave of psychological findings into economics appeared even more daunting 20 years ago, and that challenge has been met with considerable success.

REFERENCES

Agnoli, Franca. "Development of Judgmental Heuristics and Logical Reasoning: Training Counteracts the Representativeness Heuristic." *Cognitive Development*, April–June 1991, *6*(2), pp. 195–217.

Agnoli, Franca and Krantz, David H. "Suppressing Natural Heuristics by Formal Instruction: The Case of the Conjunction Fallacy." *Cognitive Psychology*, October 1989, *21*(4), pp. 515–50.

Alevy, Jonathan E.; List, John A. and Adamowicz, Wiktor. "More is Less: Preference Reversals and Non-Market Valuations." Working paper, University of Maryland, 2003.

Ariely, Dan. "Seeing Sets: Representation by Statistical Properties." *Psychological Science*, March 2001, *12*(2), pp. 157–62.

Ariely, Dan and Loewenstein, George. "When Does Duration Matter in Judgment and Decision Making?" *Journal of Experimental Psychology: General*, December 2000, *129*(4), pp. 508–23.

Arrow, Kenneth J. "Risk Perception in Psychology and Economics." *Economic Inquiry*, January 1982, *20*(1), pp. 1–9.

Barber, Brad M. and Odean, Terrance. "Trading is Hazardous to Your Wealth: The Common Stock Investment Performance of Individual Investors." *Journal of Finance*, April 2000, *55*(2), pp. 773–806.

Barberis, Nicholas; Huang, Ming and Thaler, Richard H. "Individual Preferences, Monetary Gambles and the Equity Premium." National Bureau of Economic Research (Cambridge, MA) Working Paper No. W9997, May 2003.

Bargh, John A. "The Automaticity of Everyday Life," in Robert S. Wyer, Jr., ed., *The automaticity of everyday life: Advances in social cognition*, Vol. 10. Mahwah, NJ: Erlbaum, 1997, pp. 1–61.

Benartzi, Shlomo and Thaler, Richard H. "Myopic Loss Aversion and the Equity Premium Puzzle." *Quarterly Journal of Economics*, February 1995, *110*(1), pp. 73–92.

_____. "Risk Aversion or Myopia? Choices in Repeated Gambles and Retirement Investments." *Management Science*, March 1999, *47*(3), pp. 364–81.

_____. "Naïve Diversification Strategies in Defined Contribution Saving Plans." *American Economic Review*, March 2001, *91*(1), pp. 79–98.

Bernoulli, Daniel. "Exposition of a New Theory on the Measurement of Risk." *Econometrica*, January 1954, *22*(1), pp. 23–36. (Original work published 1738.)

Bless, Herbert; Clore, Gerald L.; Schwarz, Norbert; Golisano, Verana; Rabe, Christian and Wolk, Marcus. "Mood and the Use of Scripts: Does a Happy Mood Really Lead to Mindlessness?" *Journal of Personality and Social Psychology*, October 1996, *71*(4), pp. 665–79.

Bodenhausen, Galen V. "Stereotypes as Judgmental Heuristics: Evidence of Circadian Variations in Discrimination." *Psychological Science*, September 1990, *1*(5), pp. 319–22.

Bruner, Jerome S. and Minturn, A. Leigh. "Perceptual Identification and Perceptual Organization." *Journal of General Psychology*, July 1955, *53*, pp. 21–28.

Camerer, Colin F. and Hogarth, Robin M. "The Effect of Financial Incentives." *Journal of Risk and Uncertainty*, December 1999, *19*(1–3), pp. 7–42.

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Camerer, Colin F.; Loewenstein, George and Rabin, Matthew, eds. *Advances in behavioral economics*. Princeton, NJ: Princeton University Press (forthcoming).

Carson, Richard T. "Contingent Valuation Surveys and Tests of Insensitivity to Scope," in R. J. Kopp, W. W. Pommerhene, and N. Schwartz, eds., *Determining the value of nonmarketed goods: Economic, psychological, and policy relevant aspects of contingent valuation methods*. Boston, MA: Kluwer, 1997, pp. 127–63.

Chaiken, Shelly and Trope, Yaacov, eds. *Dual-process theories in social psychology*. New York: Guilford Press, 1999.

Chapman, Gretchen B. and Johnson, Eric J. "Incorporating the Irrelevant: Anchors in Judgments of Belief and Value," in Thomas Gilovich, Dale Griffin, and Daniel Kahneman, eds., *Heuristics and biases: The psychology of intuitive thought*. New York: Cambridge University Press, 2002, pp. 120–38.

Choi, James J.; Laibson, David; Madrian, Brigitte and Metrick, Andrew. "Defined Contribution Pensions: Plan Rules, Participant Decisions and the Path of Least Resistance," in James M. Poterba, ed., *Tax policy and the economy*, Vol. 16. Cambridge, MA: MIT Press, 2002, pp. 67–113.

Chong, Sang-Chul and Treisman, Anne. "Representation of Statistical Properties." *Vision Research*, February 2003, *43*(4), pp. 393–404.

Cohen, David and Knetsch, Jack L. "Judicial Choice and Disparities Between Measures of Economic Value." *Osgoode Hall Law Review*, 1992, *30*(3), pp. 737–70.

Cosmides, Leda and Tooby, John. "Are Humans Good Intuitive Statisticians After All? Rethinking Some Conclusions From the Literature on Judgment and Uncertainty." *Cognition*, January 1996, *58*(1), pp. 1–73.

De Bondt, Werner F. M. and Thaler, Richard H. "Does the Stock Market Overreact?" *Journal of Finance*, July 1985, *40*(3), pp. 793–808.

Desvousges, William H.; Johnson, F. Reed; Dunford, Richard W.; Hudson, Sara P.; Wilson, K. Nichole and Boyle, Kevin J. "Measuring Natural Resource Damages with Contingent Valuation: Tests of Validity and Reliability," in Jerry A. Hausman, ed., *Contingent valuation: A critical assessment*. Amsterdam: North-Holland, 1993, pp. 91–164.

Diamond, Peter A. "A Framework for Social Security Analysis." *Journal of Public Economics*, December 1977, *8*(3), pp. 275–98.

_____. "Testing the Internal Consistency of Contingent Valuation Surveys." *Journal of Environmental Economics and Management*, May 1996, *30*(3), pp. 155–73.

Elster, Jon. "Emotions and Economic Theory." *Journal of Economic Literature*, March 1998, *26*(1), pp. 47–74.

Epstein, Seymour. "Cognitive-Experiential Self-Theory of Personality," in Theodore Millon and Melvin J. Lerner, eds., *Comprehensive handbook of psychology, volume 5: Personality and social psychology*. Hoboken, NJ: Wiley & Sons, 2003, pp. 159–84.

Evans, Jonathan St. B. T.; Handley, Simon J.; Over, David E. and Perham, Nicholas. "Background Beliefs in Bayesian Inference." *Memory and Cognition*, March 2002, *30*(2), pp. 179–90.

Finucane, Melissa L.; Alhakami, Ali; Slovic, Paul and Johnson, Stephen M. "The Affect Heuristic in Judgments of Risks and Benefits." *Journal of Behavioral Decision Making*, January/March 2000, *13*(1), pp. 1–17.

Fiske, Susan T. "Stereotyping, Prejudice, and Discrimination," in Daniel T. Gilbert, Susan T. Fiske, and Gardner Lindzey, eds., *The handbook of social psychology*, 4th Ed., Vol. 1. New York: McGraw-Hill, 1998, pp. 357–411.

Frederick, Shane W. and Fischhoff, Baruch. "Scope (In)sensitivity in Elicited Valuations." *Risk, Decision, and Policy*, August 1998, *3*(2), pp. 109–23.

Fredrickson, Barbara L. and Kahneman, Daniel. "Duration Neglect in Retrospective Evaluations of Affective Episodes." *Journal of Personality and Social Psychology*, July 1993, *65*(1), pp. 45–55.

Gawande, Atul. *Complications: A surgeon's notes on an imperfect science*. New York: Metropolitan Books, 2002.

Genesove, David and Mayer, Christopher J. "Loss Aversion and Seller Behavior: Evidence from the Housing Market." *Quarterly Journal of Economics*, November 2001, *116*(4), pp. 1233–60.

Gigerenzer, Gerd; Swijtink, Zeno; Porter, Theodore; Daston, Lorraine; Beatty, John and Kruger, Lorenz. *The empire of chance: How probability changed science and everyday*

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life. Cambridge: Cambridge University Press, 1989.

Gilbert, Daniel T. "Thinking Lightly About Others: Automatic Components of the Social Inference Process," in James S. Uleman and John A. Bargh, eds., *Unintended thought*. Englewood Cliffs, NJ: Prentice-Hall, 1989, pp. 189–211.

_____. "How Mental Systems Believe." *American Psychologist*, February 1991, *46*(2), pp. 107–19.

_____. "Inferential Correction," in Thomas Gilovich, Dale Griffin, and Daniel Kahneman, eds., *Heuristics and biases: The psychology of intuitive thought*. New York: Cambridge University Press, 2002, pp. 167–84.

Grether, David M. "Recent Psychological Studies of Behavior Under Uncertainty." *American Economic Review*, May 1978 (*Papers and Proceedings*), *68*(2), pp. 70–74.

Higgins, E. Tory. "Knowledge Activation: Accessibility, Applicability, and Salience," in E. Tory Higgins and Arie W. Kruglanski, eds., *Social psychology: Handbook of basic principles*. New York: Guilford Press, 1996, pp. 133–68.

Hsee, Christopher K. "The Evaluability Hypothesis: An Explanation of Preference Reversals Between Joint and Separate Evaluations of Alternatives." *Organizational Behavior and Human Decision Processes*, September 1996, *67*(3), pp. 247–57.

_____. "Less is Better: When Low-Value Options are Valued More Highly Than High-Value Options." *Journal of Behavioral Decision Making*, June 1998, *11*(2), pp. 107–21.

Isen, Alice M.; Nygren, Thomas E. and Ashby, F. Gregory. "Influence of Positive Affect on the Subjective Utility of Gains and Losses: It is Just Not Worth the Risk." *Journal of Personality and Social Psychology*, November 1988, *55*(5), pp. 710–17.

Johnson, Eric J. and Goldstein, Daniel G. "Do Defaults Save Lives?" Working paper, Center for Decision Sciences, Columbia University, 2003.

Johnson, Eric J.; Hershey, John; Meszaros, Jacqueline and Kunreuther, Howard. "Framing, Probability Distortions, and Insurance Decisions." *Journal of Risk and Uncertainty*, August 1993, *7*(1), pp. 35–51.

Kahneman, Daniel. "Comment," in Ronald G. Cummings, David S. Brookshire, and William D. Schultze, eds., *Valuing environmental goods*. Totowa, NJ: Rowman and Allenheld, 1986, pp. 185–93.

_____. "New Challenges to the Rationality Assumption." *Journal of Institutional and Theoretical Economics*, March 1994, *150*(1), pp. 18–36.

_____. "Evaluation by Moments: Past and Future," in Daniel Kahneman and Amos Tversky, eds., *Choices, values, and frames*. New York: Cambridge University Press, 2000a, pp. 693–708.

_____. "Experienced Utility and Objective Happiness: A Moment-Based Approach," in Daniel Kahneman and Amos Tversky, eds., *Choices, values, and frames*. New York: Cambridge University Press, 2000b, pp. 673–92.

_____. "A Psychological Perspective on Economics." *American Economic Review*, May 2003a (*Papers and Proceedings*), *93*(2), pp. 162–68.

_____. "A Perspective on Judgment and Choice: Mapping Bounded Rationality." *American Psychologist*, September 2003b, *56*(9), pp. 697–720.

Kahneman, Daniel and Frederick, Shane. "Representativeness Revisited: Attribute Substitution in Intuitive Judgment," in Thomas Gilovich, Dale Griffin, and Daniel Kahneman, eds., *Heuristics and biases: The psychology of intuitive thought*. New York: Cambridge University Press, 2002, pp. 49–81.

Kahneman, Daniel; Fredrickson, Barbara L.; Schreiber, Charles A. and Redelmeier, Donald A. "When More Pain is Preferred to Less: Adding a Better End." *Psychological Science*, November 1993, *4*(6), pp. 401–05.

Kahneman, Daniel; Knetsch, Jack and Thaler, Richard. "Fairness as a Constraint on Profit-seeking: Entitlements in the Market." *American Economic Review*, September 1986, *76*(4), pp. 728–41.

_____. "Experimental Tests of the Endowment Effect and the Coase Theorem." *Journal of Political Economy*, December 1990, *98*(6), pp. 1325–48.

_____. "The Endowment Effect, Loss Aversion, and Status Quo Bias: Anomalies." *Journal of Economic Perspectives*, Winter 1991, *5*(1), pp. 193–206.

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Kahneman, Daniel and Lovallo, Daniel. "Timid Choices and Bold Forecasts: A Cognitive Perspective on Risk Taking." *Management Science*, January 1993, *39*(1), pp. 17–31.

Kahneman, Daniel; Ritov, Ilana and Schkade, David. "Economic Preferences or Attitude Expressions? An Analysis of Dollar Responses to Public Issues." *Journal of Risk and Uncertainty*, December 1999, *19*(1–3), pp. 203–35.

Kahneman, Daniel; Slovic, Paul and Tversky, Amos, eds. *Judgment under uncertainty: Heuristics and biases*. New York: Cambridge University Press, 1982.

Kahneman, Daniel and Tversky, Amos. "On the Psychology of Prediction." *Psychological Review*, July 1973, *80*(4), pp. 237–51.

_____. "Prospect Theory: An Analysis of Decisions Under Risk." *Econometrica*, March 1979, *47*(2), pp. 263–91.

_____, eds. *Choices, values, and frames*. New York: Cambridge University Press, 2000.

Kahneman, Daniel; Wakker, Peter P. and Sarin, Rakesh. "Back to Bentham? Explorations of Experienced Utility." *Quarterly Journal of Economics*, May 1997, *112*(2), pp. 375–405.

Keren, Gideon and Wagenaar, Willem A. "Violations of Utility Theory in Unique and Repeated Gambles." *Journal of Experimental Psychology: Learning, Memory, and Cognition*, July 1987, *13*(3), pp. 387–91.

Klein, Gary. *Sources of power: How people make decisions*. Cambridge, MA: MIT Press, 1998.

_____. *Intuition at work: Why developing your gut instincts will make you better at what you do*. New York: Doubleday, 2003.

Koehler, Jonathan Jay. "The Base-Rate Fallacy Reconsidered: Descriptive, Normative, and Methodological Challenges." *Behavioral and Brain Sciences*, March 1996, *19*, pp. 1–53.

Kopp, Raymond. "Why Existence Value Should be Used in Cost-Benefit Analysis." *Journal of Policy Analysis and Management*, Winter 1992, *11*(1), pp. 123–30.

Kunreuther, Howard. "The Changing Societal Consequences of Risks From Natural Hazards." *Annals of the American Academy of Political and Social Science*, May 1979, *443*(443), pp. 104–16.

Langer, Ellen J.; Blank, Arthur and Chanowitz, Benzion. "The Mindlessness of Ostensibly Thoughtful Action: The Role of 'Placebic' Information in Interpersonal Interaction." *Journal of Personality and Social Psychology*, June 1978, *36*(6), pp. 635–42.

LeDoux, Joseph E. "Emotion Circuits in the Brain." *Annual Review of Neuroscience*, March 2000, *23*, pp. 155–84.

Lerner, Jennifer S. and Tetlock, Philip E. "Accounting for the Effects of Accountability." *Psychological Bulletin*, March 1999, *125*(2), pp. 255–75.

List, John A. "Preference Reversals of a Different Kind: The 'More Is Less' Phenomenon." *American Economic Review*, December 2002, *92*(5), pp. 1636–43.

_____. "Does Market Experience Eliminate Market Anomalies?" *Quarterly Journal of Economics*, February 2003a, *118*(1), pp. 47–71.

_____. "Neoclassical Theory Versus Prospect Theory: Evidence From the Marketplace." National Bureau of Economic Research (Cambridge, MA) Working Paper No. W9736, 2003b; *Econometrica*, 2004 (forthcoming).

Loewenstein, George. "Out of Control: Visceral Influences on Behavior." *Organizational Behavior and Human Decision Processes*, March 1996, *65*(3), pp. 272–92.

_____. "Emotions in Economic Theory and Economic Behavior." *American Economic Review*, May 2000 (*Papers and Proceedings*), *90*(2), pp. 426–32.

Loewenstein, George; Weber, Elke U.; Hsee, Christopher K. and Welch, N. "Risk as Feelings." *Psychological Bulletin*, March 2001, *127*(2), pp. 267–86.

Luce, R. Duncan; Krantz, David H.; Suppes, Patrick and Tversky, Amos. *Foundations of measurement, volume 3: Representation, axiomatization, and invariance*. San Diego, CA: Academic Press, 1990.

Madrian, Brigitte and Shea, Dennis. "The Power of Suggestion: Inertia in 401(k) Participation and Savings Behavior." *Quarterly Journal of Economics*, November 2001, *116*(4), pp. 1149–87.

Mellers, Barbara. "Choice and the Relative Pleasure of Consequences." *Psychological Bulletin*, November 2000, *126*(6), pp. 910–24.

Nisbett, Richard E.; Krantz, David H.; Jepson, Christopher and Kunda, Ziva. "The Use of Statistical Heuristics in Everyday Inductive

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Reasoning." *Psychological Review*, October 1983, *90*(4), pp. 339–63.

Pashler, Harold E. *The psychology of attention.* Cambridge, MA: MIT Press, 1998.

Posner, Michael I. and Keele, Stephen W. "On the Genesis of Abstract Ideas." *Journal of Experimental Psychology*, Pt. 1, 1968, *77*(3), pp. 353–63.

Rabin, Matthew. "Inference by Believers in the Law of Small Numbers." *Quarterly Journal of Economics*, August 2002, *17*(3), pp. 775–816.

Read, Daniel; Loewenstein, George and Rabin, Matthew. "Choice Bracketing." *Journal of Risk and Uncertainty*, December 1999, *19*(1–3), pp. 171–97.

Redelmeier, Donald A. and Kahneman, Daniel. "Patients' Memories of Painful Medical Treatments: Real-time and Retrospective Evaluations of Two Minimally Invasive Procedures." *Pain*, July 1996, *66*(1), pp. 3–8.

Redelmeier, Donald A.; Katz, Joel and Kahneman, Daniel. "Memories of Colonoscopy: A Randomized Trial." *Pain*, July 2003, *104*(1–2), pp. 187–94.

Rosch, Eleanor and Mervis, Carolyn B. "Family Resemblances: Studies in the Internal Structure of Categories." *Cognitive Psychology*, October 1975, *7*(4), pp. 573–605.

Ross, Lee and Nisbett, Richard E. *The person and the situation.* New York: McGraw-Hill, 1991.

Rottenstreich, Yuval and Hsee, Christopher K. "Money, Kisses and Electric Shocks: On the Affective Psychology of Risk." *Psychological Science*, May 2001, *12*(3), pp. 185–90.

Rozin, Paul and Nemeroff, Carol. "Sympathetic Magical Thinking: The Contagion and Similarity Heuristics," in Thomas Gilovich, Dale Griffin, and Daniel Kahneman, eds., *Heuristics and biases: The psychology of intuitive thought.* New York: Cambridge University Press, 2002, pp. 201–16.

Samuelson, William and Zeckhauser, Richard. "Status Quo Bias in Decision Making." *Journal of Risk and Uncertainty*, March 1988, *1*(1), pp. 7–59.

Schelling, Thomas C. *Choice and consequence: Perspectives of an errant economist.* Cambridge, MA: Harvard University Press, 1984.

Schreiber, Charles A. and Kahneman, Daniel. "Determinants of the Remembered Utility of Aversive Sounds." *Journal of Experimental Psychology: General*, March 2000, *129*(1), pp. 27–42.

Shafir, Eldar and LeBoeuf, Robyn A. "Rationality." *Annual Review of Psychology*, February 2002, *53*(1), pp. 419–517.

Shiller, Robert J. *Irrational exuberance.* Princeton, NJ: Princeton University Press, 2000.

Shleifer, Andrei. *Inefficient markets: An introduction to behavioral finance.* New York: Oxford University Press, 2000.

Simon, Herbert A. "A Behavioral Model of Rational Choice." *Quarterly Journal of Economics*, February 1955, *69*(1), pp. 99–118.

_____. "Information Processing Models of Cognition." *Annual Review of Psychology*, February 1979, *30,* pp. 363–96.

Simon, Herbert A. and Chase, William G. "Skill in Chess." *American Scientist*, July 1973, *61*(4), pp. 394–403.

Sloman, Steven A. "Two Systems of Reasoning," in Thomas Gilovich, Dale Griffin, and Daniel Kahneman, eds., *Heuristics and biases: The psychology of intuitive thought.* New York: Cambridge University Press, 2002, pp. 379–96.

Slovic, Paul; Finucane, Melissa; Peters, Ellen and MacGregor, Donald G. "The Affect Heuristic," in Thomas Gilovich, Dale Griffin, and Daniel Kahneman, eds., *Heuristics and biases: The psychology of intuitive thought.* New York: Cambridge University Press, 2002, pp. 397–420.

Stanovich, Keith E. and West, Richard F. "Individual Differences in Reasoning: Implications for the Rationality Debate?" *Behavioral and Brain Sciences*, October 2000, *23*(5), pp. 645–65.

_____. "Individual Differences in Reasoning: Implications for the Rationality Debate?" in Thomas Gilovich, Dale Griffin, and Daniel Kahneman, eds., *Heuristics and biases: The psychology of intuitive thought.* New York: Cambridge University Press, 2002, pp. 421–40.

Strack, Fritz; Martin, Leonard and Schwarz, Norbert. "Priming and Communication: Social Determinants of Information Use in Judgments of Life Satisfaction." *European Journal of Social Psychology*, October–November 1988, *18*(5), pp. 429–42.

Thaler, Richard H. "Toward a Positive Theory of Consumer Choice." *Journal of Economic*

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Behavior and Organization, March 1980, *1*(1), pp. 36–90.

_____. "Mental Accounting and Consumer Choice." *Marketing Science*, Summer 1985, *4*(3), pp. 199–214.

_____. *Quasi rational economics*. New York: Russell Sage Foundation, 1991.

_____. *The winner's curse: Paradoxes and anomalies of economic life*. New York: Free Press, 1992.

_____. "Mental Accounting Matters." *Journal of Behavioral Decision Making*, July 1999, *12*(3), pp. 183–206.

_____. "Toward a Positive Theory of Consumer Choice," in Daniel Kahneman and Amos Tversky, eds., *Choices, values, and frames*. New York: Cambridge University Press, 2000, pp. 268–87.

Tversky, Amos and Kahneman, Daniel. "Judgment under Uncertainty: Heuristics and Biases." *Science*, September 1974, *185*(4157), pp. 1124–31.

_____. "The Framing of Decisions and the Psychology of Choice." *Science*, January 1981, *211*(4481), pp. 453–58.

_____. "Extensional Versus Intuitive Reasoning: The Conjunction Fallacy in Probability Judgment." *Psychological Review*, October 1983, *90*(4), pp. 293–315.

_____. "Rational Choice and the Framing of Decisions." *Journal of Business*, October 1986, *59*(4), pp. S251–78.

_____. "Loss Aversion in Riskless Choice: A Reference-Dependent Model." *Quarterly Journal of Economics*, November 1991, *106*(4), pp. 1039–61.

_____. "Advances in Prospect Theory: Cumulative Representation of Uncertainty." *Journal of Risk and Uncertainty*, October 1992, *5*(4), pp. 297–323.

Tversky, Amos and Redelmeier, Donald A. "On the Framing of Multiple Prospects." *Psychological Science*, May 1992, *3*(3), pp. 191–93.

Wilson, Timothy D. *Strangers to ourselves: Discovering the adaptive unconscious*. Cambridge, MA: Harvard University Press, 2002.

Wilson, Timothy D. and Schooler, Jonathan W. "Thinking Too Much: Introspection Can Reduce the Quality of Preferences and Decisions." *Journal of Personality and Social Psychology*, February 1991, *60*(2), pp. 181–92.

Zajonc, Robert B. "Emotions," in Daniel T. Gilbert, Susan T. Fiske, and Gardner Lindzey, eds., *Handbook of social psychology*, 4th Ed., Vol. 1. New York: Oxford University Press, 1998, pp. 591–632.

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